Listing of Claims

1. (Currently amended) A magnetic resonance method ~~to determine changes in microvascular blood volume without the use of exogenous contrast or endogenous paramagnetic contrast using the parenchymal tissue signal, the method~~ including:

performing a blood signal-reduction magnetic resonance excitation sequence that substantially reduces a magnetic resonance signal from blood while substantially retaining parenchymal tissue signal;

subsequent to the performing of the blood signal-reduction magnetic resonance excitation sequence, performing a readout magnetic resonance sequence to acquire a magnetic resonance signal arising predominantly from parenchymal tissue; and

determining a microvascular blood volume parameter based on the acquired magnetic resonance signal arising predominantly from parenchymal tissue.

2. (Currently amended) ~~The~~ A magnetic resonance method ~~as set forth in claim 1,~~ including:

performing a blood signal-reduction magnetic resonance excitation sequence that substantially reduces a magnetic resonance signal from blood while substantially retaining parenchymal tissue signal wherein the performing of a blood signal-reduction magnetic resonance sequence includes[[:]] performing [[an]] a spatially non-selective inversion recovery magnetic resonance excitation sequence having an inversion time to substantially reduce the magnetic resonance signal from blood;

subsequent to the performing of the blood signal-reduction magnetic resonance excitation sequence, performing a readout magnetic resonance sequence to acquire a magnetic resonance signal arising predominantly from parenchymal tissue; and

determining a microvascular blood volume parameter based on the acquired magnetic resonance signal arising predominantly from parenchymal tissue.

3. (Currently amended) The magnetic resonance method as set forth in claim **2**, wherein the performing of [[an]] a spatially non-selective inversion recovery magnetic resonance sequence includes:

applying [[an]] a spatially non-selective inversion radio frequency pulse;

delaying for the inversion time; and

applying an excitation radio frequency pulse.

4. (Currently amended) The magnetic resonance method as set forth in claim **3**, wherein:

the applying of the spatially non-selective inversion radio frequency pulse is performed without an accompanying spatially selective magnetic gradient pulse; and

the applying of the excitation radio frequency pulse is performed with an accompanying spatially selective magnetic field gradient pulse.

5. (Currently amended) The magnetic resonance method as set forth in claim **3**, wherein the performing of [[an]] a spatially non-selective inversion recovery magnetic resonance sequence further includes:

after the inversion time, to maintain the substantial reduction in the magnetic resonance signal from blood, applying additional spatially non-selective inversion radio frequency pulses.

6-11. (Canceled)

12. (Previously presented) The magnetic resonance method as set forth in claim **1**, further including:

generating a reconstructed image from the acquired magnetic resonance signal.

13. (Previously presented) The magnetic resonance method as set forth in claim **12**, further including:

subsequent to performing the readout magnetic resonance sequence, inducing a physiological perturbation;

subsequent to inducing the physiological perturbation, repeating performing the blood signal-reduction magnetic resonance excitation sequence and performing the readout magnetic resonance sequence to acquire a second magnetic resonance signal arising predominantly from parenchymal tissue; and

generating a perturbation reconstructed image from the acquired second magnetic resonance signal.

14. (Previously presented) The magnetic resonance method as set forth in claim **12**, further including:

subsequent to performing the readout magnetic resonance sequence, inducing a physiological perturbation;

subsequent to inducing the physiological perturbation, repeating performing the blood signal-reduction magnetic resonance excitation sequence;

subsequent to repeating the performing of the blood signal-reduction magnetic resonance excitation sequence, performing a plurality of readout magnetic resonance sequences each having a different echo time to acquire a plurality of magnetic resonance signals corresponding to the plurality of echo times;

generating a plurality of perturbation reconstructed images from the acquired plurality of magnetic resonance signals corresponding to the plurality of echo times, the determining of the microvascular blood volume parameter being based on a temporal evolution of a physiological response to the physiological perturbation based on the plurality of perturbation reconstructed images.

15. (Previously presented) The magnetic resonance method as set forth in claim **14**, wherein the determining of the microvascular blood volume parameter includes:

computing a change in vascular space occupancy signal between perturbation reconstructed images and corresponding unperturbed reconstructed images for each echo time to produce change in vascular space occupancy signal versus echo time data; and

fitting the change in vascular space occupancy signal versus echo time data to a mathematical model to obtain a blood volume parameter value.

16. (Previously presented) The magnetic resonance method as set forth in claim **12**, further including:

computing a tissue magnetization based on the T1 value of the tissue;

generating a normalized reconstructed image by dividing the reconstructed image by the tissue magnetization; and

estimating a blood volume parameter value based on the normalized reconstructed image.

17. (Canceled)

18. (Previously presented) The magnetic resonance method as set forth in claim **12**, wherein performing the readout magnetic resonance sequence effects imaging of a subject brain region of a subject brain, and the method further includes:

providing a reference image of a reference brain region; and

comparing the reconstructed image with the reference image to detect an abnormality of the subject brain region.

19. (Previously presented) The magnetic resonance method as set forth in claim **18**, wherein providing the reference image of a reference brain region includes repeating:

performing the blood signal-reduction magnetic resonance excitation sequence,

performing the readout magnetic resonance sequence, and

generating the reconstructed image on the reference brain region to generate the reference image.

20. (Original) The magnetic resonance method as set forth in claim **19**, wherein the reference brain region is selected from a group consisting of:

a brain region of a contralateral side of the subject brain corresponding to the subject brain region,

a brain region of a brain other than the subject brain which corresponds to the subject brain region, and

a brain region of the subject brain other than the subject brain region.

21. (Canceled)

22. (Previously presented) The magnetic resonance method as set forth in claim **2**, wherein performing the readout magnetic resonance sequence to acquire a magnetic resonance signal arising predominantly from parenchymal tissue includes performing one or more of:

a single-shot imaging sequence,

a single-shot echo planar sequence,

a multi-shot imaging sequence,

a spectroscopy sequence,

a multiple slice image,

a one-dimensional, two-dimensional, or three dimensional spatial encoding sequence,

a fractional k-space acquisition sequence,

a spin echo readout sequence, and

a gradient echo readout sequence.

23. (Currently amended) A magnetic resonance system ~~configured to determine changes in microvascular blood volume without the use of exogenous contrast or endogenous paramagnetic contrast using the parenchymal tissue signal, the system~~ including:

a blood signal reduction means for performing a blood signal reduction magnetic resonance excitation sequence that substantially reduces a magnetic resonance signal from blood while retaining an effective parenchymal tissue signal;

a readout means for performing a readout magnetic resonance sequence to acquire a magnetic resonance signal arising predominantly from parenchymal tissue, the readout means operating subsequent to operation of the blood ~~nulling~~ signal reduction means;

a reconstruction means for generating a reconstructed image from the acquired magnetic resonance signal; and

a means for computing a blood volume parameter value from the reconstructed image, the means for computing a blood volume parameter value including at least one of:

(i) means for normalizing the reconstructed image based on a T1 value of tissue to generate a tissue-normalized reconstructed image and means for computing the blood volume from the tissue-normalized reconstructed image, and

(ii) means for computing an intermediate parameter functionally related to blood volume for a plurality of reconstructed images produced by repetitively invoking the readout means and the reconstruction means with a corresponding plurality of echo times and means for fitting a parameterized model to the intermediate parameters and the corresponding echo times, the parameterized model having parameters including a rest blood volume and a blood volume change.

24. (Previously presented) The magnetic resonance system as set forth in claim **23**, wherein the blood signal reduction means includes:

an inversion recovery means for performing an inversion recovery magnetic resonance excitation sequence having an inversion time effective to produce a substantially reduced blood signal.

25-28. (Canceled)

29. (Previously presented) The magnetic resonance system as set forth in claim **23**, wherein the means for computing a blood volume parameter value includes:

a means for normalizing the reconstructed image based on a T1 value of tissue to generate a tissue-normalized reconstructed image; and

a means for computing the blood volume from the tissue-normalized reconstructed image.

30. (Previously presented) The magnetic resonance system as set forth in claim **23**, wherein the means for computing a blood volume parameter value includes:

a means for computing an intermediate parameter functionally related to blood volume for a plurality of reconstructed images produced by repetitively invoking the readout means and the reconstruction means with a corresponding plurality of echo times; and

a means for fitting a parameterized model to the intermediate parameters and the corresponding echo times, the parameterized model having parameters including a rest blood volume and a blood volume change.

31. (Previously presented) The magnetic resonance system as set forth in claim **23**, further including:

a means for combining the reconstructed image with a reference image to identify an abnormality in the reconstructed image.

32. (Previously presented) A magnetic resonance method for assessing microvascular blood volume, the method comprising:

acquiring a parenchymal tissue magnetic resonance signal from parenchymal tissue under different parenchymal blood volume perturbing conditions that change the vascular space occupancy within the parenchymal tissue; and

determining a parenchymal vascular space occupancy-related parameter based on the acquired parenchymal tissue magnetic resonance signals.

33. (Previously presented) The magnetic resonance method as set forth in claim **32**, wherein the acquiring comprises:

(i) performing a blood signal-reduction magnetic resonance excitation sequence that substantially reduces a magnetic resonance signal from blood relative to a magnetic resonance signal from parenchymal tissue; and

(ii) acquiring the parenchymal tissue magnetic resonance signal with the magnetic resonance signal from blood substantially reduced relative to the magnetic resonance signal from parenchymal tissue by the performing operation (i).

34. (Previously presented) The magnetic resonance method as set forth in claim **32**, wherein the determining comprises:

computing change in vascular space occupancy caused by the different parenchymal blood volume perturbing conditions.